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The Dermestid Beetle Method of Skull Preparation

By B. J. KRUGER

INTRODUCTION

In the preparation of a skull of an experimental animal for the examination of dental caries, it is usual practice to dissect the soft tissues, separate the mandible from the rest of the skull and then to preserve the specimen, *e.g.* in 10% formalin. Sometimes the specimens are given a preliminary boil in soap and water or are autoclaved. Both the preparation and the subsequent examination of wet specimens under a binocular microscope are messy and time consuming.

Klapper (1954) described the dermestid beetle technique, and recommended it to other investigators. However, the method does not seem to have been used since then, and investigators continue to use the laborious techniques of dissecting, autoclaving and preserving. It is the purpose of this article to redirect attention to Klapper's suggestion, and to describe the technique used at the University of Queensland Dental College.

There are only a few references[1] [2] [4] [5] [6] to the use of the dermestid beetle for cleaning skeletons, even though they were first used for this purpose about 1920[1] [5]. The beetle, *Dermestes maculatus Degeer*[2] has a number of common names: leather beetle (America), skin beetle (South Africa), and larder beetle (Australia).

It is usually not difficult to obtain sufficient adult beetles to start a colony, as they are widely distributed throughout the world. Most of our colony stock was obtained from the hoof room of the local abattoir. With correct conditions for growth, it has been found that only about one dozen adult beetles are needed to start a colony.

METHOD

The general outline of our laboratory method for cleaning skulls varies slightly from the description given by Klapper[3] (1954). Instead of housing the colony in glass jars, we have used a 14in. x 10in. x 7in. deep wooden box lined with tin. The lining was brought to the outer edges of the box to prevent the larvae of the beetles from pupating in any exposed wood. The box was provided with a tightly fitting lid in which there was a 9in. x 7in. insert of the finest fly-proof gauze. The whole interior was enamelled black and about one inch of pine shavings placed in the bottom—to provide a minimum of light and to protect the larvae.[4]

When an experiment was completed, all animals were sacrificed. Each decapitated head was then skinned and identified by ligating a punched metal disc through the zygomatic arch. Each skull was then placed in an individual compartment in a copper gauze container to keep the mandible with its corresponding skull after cleaning by the beetles. When the colony was thriving with some hundreds of dermestids at various stages of the life-cycle, it was found that the colony would clean thirty-six rat skulls in 48 to 72 hours.

As Klapper[3] pointed out, if the termination of any experiment provides more rat skulls than the beetle colony can accommodate at that particular time, the residue can be appropriately labelled, and stored in a refrigerator.

It has been shown that meat with a high water content is not readily eaten by the beetles and soon becomes rancid. Because of this, Klapper has suggested that refrigerated skulls be submitted to dry heat (50^0-60^0) for several hours, before being introduced to the beetles. In our laboratory, we have found this necessary in the initial stages of building up the colony and when using refrigerated skulls, but completely unnecessary when the colony is thriving. When there are no skulls to be cleaned, the beetles can be maintained with meat and bone, *e.g.* lean chops.

Klapper[3] suggests that after cleaning, the skulls be degreased in dilute ammonium hydroxide for 12 hours, washed in running water for several hours and then dried. In our laboratory this method has also been used and found to be satisfactory. However, a quicker method is to bleach the skulls in 30 vols. hydrogen peroxide for several minutes, wash in running water and dry. The skulls can then be numbered in marking ink and filed in boxes.

There are a number of advantages which make the dermestid beetle method more suitable than other techniques for preparing skulls for *dental caries evaluation:*

—the skulls are cleaner, more easily branded and more conveniently stored.
—the teeth remain firmly held in their sockets, which makes for easier and more accurate grinding of successive planes (used in most caries evaluations).
—the examination for caries is more easily performed because the tooth surfaces are dry and relatively free of debris.

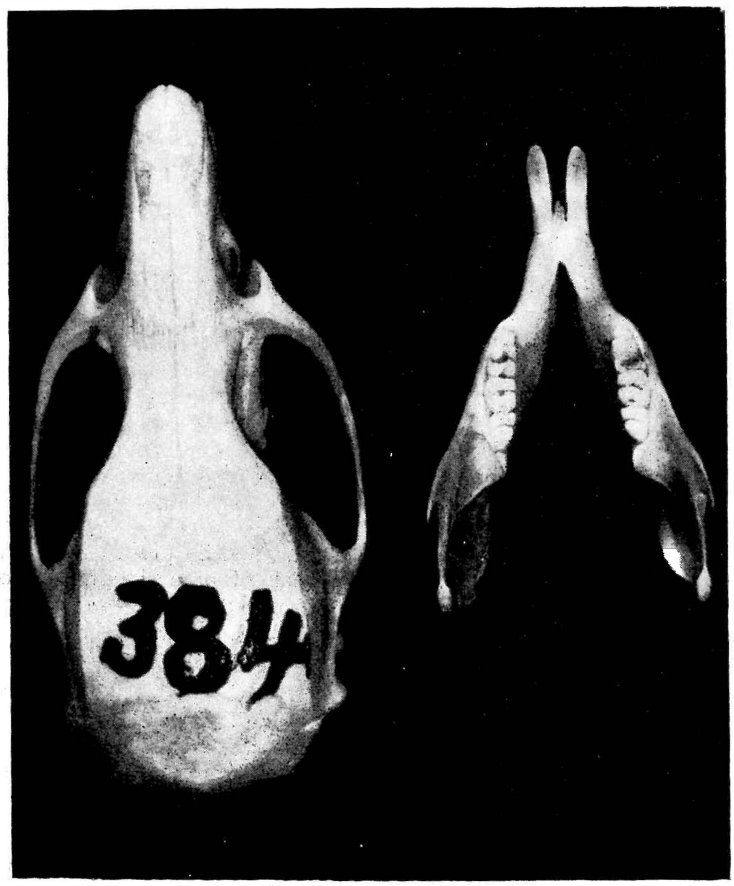

FIG. 1—Rat skull and mandible cleaned by dermestid beetles.

Results

An example of the cleaning of a rat skull is shown in Figs. 1 and 2. The method has also been used for preparing other skulls as museum specimens. Figs. 3 and 4 show views of a duck skull; the horny plates were not attacked by the beetles.

Conclusions

The dermestid beetle method of cleaning skulls has been described and its many advantages discussed. Very little use seems to have been made of the dermestid beetle for this purpose. The method has been found to conserve time, to produce cleaner preparations and to be generally more satisfactory than other techniques. This article confirms the findings of Klapper and adds to his recommendation that other investigators avail themselves of the method.

BIBLIOGRAPHY

1. Hall, E. R. and Russell, W. C. Dermestid beetles as an aid in cleaning bones: Extract from General Notes. *J. Mammal*, **14**: 372, 1933.
2. Hinton, H. E. A monograph of the beetles associated with stored products. Trustees of the British Museum, London, 1945.
3. Klapper, C. E. Skull cleaning with dermestid beetles. *O. Surg.*, **7**: 96-97, January, 1954.
4. Russell, W. C. Biology of the dermestid beetle with reference to skull cleaning. *J. Mammal*, **28**: 284-287, 1947.
5. Tiemier, O. W. The dermestid method of cleaning skeletons. *Kans. Univ., Sci. Bull.*, **26**: 10, 377-382, Oct., 1939.
6. Vorhies, C. J. A chest for dermestid cleaning of skulls. *J. Mammal*, **29**: 188, 1948.

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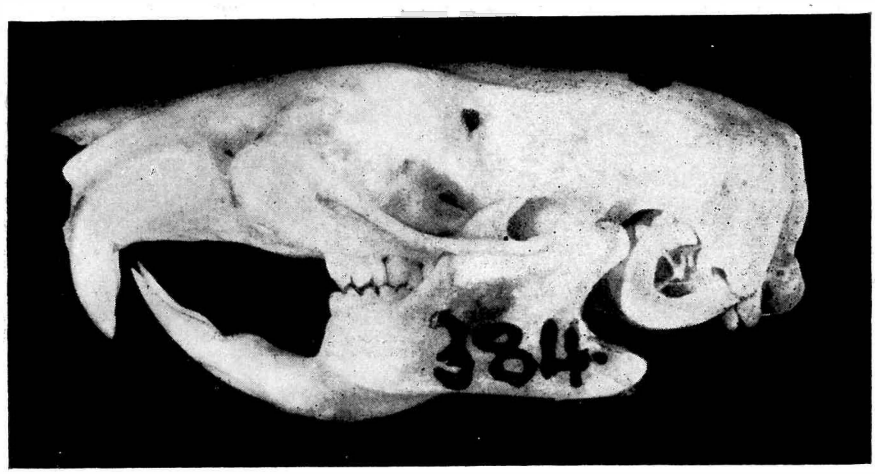

Fig. 2—Side view of rat skull and mandible shown in Figure 1.

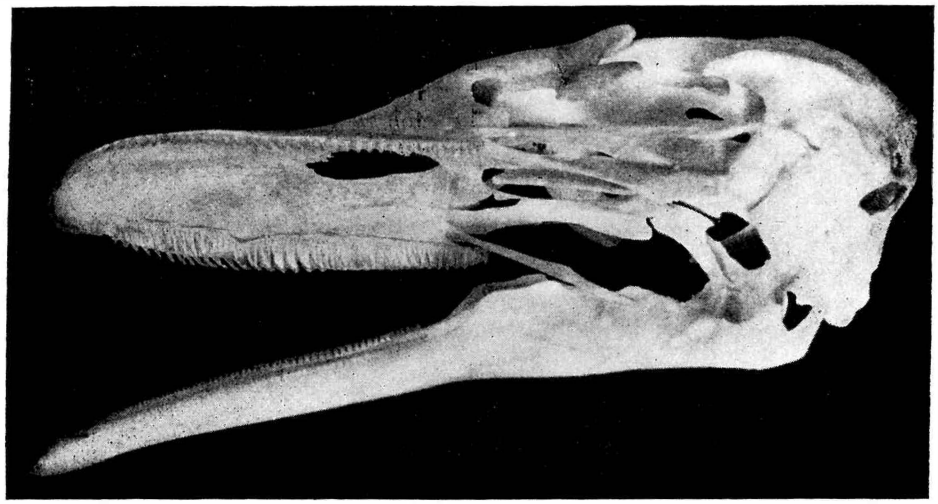

FIG. 3—Duck skull and mandible cleaned by dermestid beetles. Horny plates were not attacked by the beetles.

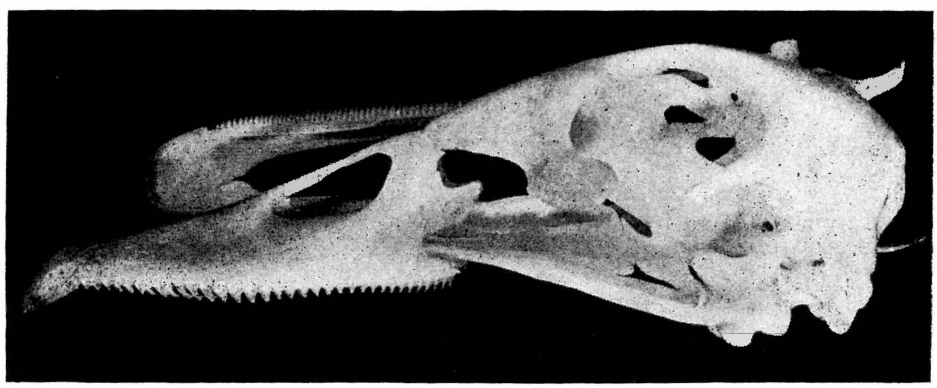

FIG. 4—Side view of specimen shown in Figure 3.

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Local Anaesthetics. A Survey of Their Use by Queensland Dentists (1958)

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Local Anaesthetics

A SURVEY OF THEIR USE BY QUEENSLAND DENTISTS (1958)

By B. J. KRUGER AND F. N. MONSOUR

INTRODUCTION

The easing of pain is fundamental in the successful practice of dentistry; most dentists prefer to use local anaesthesia. The literature abounds in research reports on local anaesthetic agents, but the main commercial testing ground is in the degree of successful use by the general practitioners.

The purpose of the present survey was to ascertain the opinions of dental practitioners in Queensland on several aspects on the use of local anaesthetics.

LITERATURE REVIEW

A large number of new local anaesthetic agents has been introduced in recent years, and many claims have been made for their pharmacological superiority. Unfortunately, there is no absolutely satisfactory method of comparing the clinical efficiency of local anaesthetics, and consequently no standard procedure for comparing the work of different investigators.

The pharmacological and clinical appraisal of the various anaesthetic agents has been well reviewed[1 2 4 5 6 14 15 16 19 20 21].

Today there is still no single anaesthetic agent which fulfils every need in dentistry. In fact, many workers[6 9 10 13 22 24] recommend that a dentist should select from a group of anaesthetic agents, rather than routinely rely on a single anaesthetic drug. A satisfactory group for a dentist would contain the following agents:

1. One of short duration.
2. One of medium duration.
3. One of long duration.
4. One of lowered toxicity suitable for "risk" patients.
5. One for obtaining a relatively bloodless field.

Mercadante and Kutscher[18] (1958) reported on a survey of New York dentists to ascertain their use of anaesthetic drugs.

MATERIALS AND METHODS

This present survey was designed to obtain the opinions of the dental practitioners of Queensland on some aspects of the use of local anaesthetics.

It would be difficult to gain the opinion of every one of the 658* dentists registered in this state, and as is customary in surveys of this kind, a sampling technique was adopted.

A sample of fifty was selected from the names of dentists listed in the 1958 Dental Register of the Queensland Dental Board. These were chosen by using random numbers (Fisher and Yates),[11] but the following limitations were placed on the inclusion of any name selected in the questionnaire sample:

1. Dentists registered as specialists were omitted.
2. Registered dentists working in the University Dental College or in Government Clinics were omitted.

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*1958 Dental Register.

This was done so that the sample might be more representative of the general practitioner.

In this type of survey, a complete response (100 per cent.) to the questionnaire is necessary, if adequate conclusions are to be inferred for the total "population". The opinions of those, who did not respond to the first enquiry, might be different from the opinions of those who did.

The first response was very good—42 out of 50. Five of the remaining eight were reminded by telephone and the other three by a second letter. Within a further three weeks a total response (100 per cent.) had been obtained.

Results from this sample of 50 cannot be extended directly to the total "population", as figures from similar randomly selected samples of 50 (from 658) would vary around the true values for the total "population". In relating these results from this present sample to the whole "population", 95 per cent. confidence limits were chosen. This means that in the long run there is a 95 per cent. probability of being correct in the making of statements about the whole population based on the results of this sample.

A copy of the questionnaire and accompanying letter appears in Fig. 1.

Results and Discussion

The appropriate totals were made for each question and are reported in Tables 1-12.

TABLE I
Anaesthetic Drugs used by Queensland dentists.

Anaesthetic	No. Using	Confidence Interval*	Proportion used	Confidence Interval*	Cartridge	Bottles
Lidocaine Type ..	44⅓	76%—95%	46.14	81%—98%	42	14
Procaine	2		1.8		1	2
N.P.C. and Novocain-Pontocaine-Noradrenalin (Dentocaine)	1⅓		1.0		2	1
Ravocaine ..	1		0.05			
Unacaine ..	⅓		0.01			
Informal ..	1		1			
TOTAL ..	50		50			

*95% Confidence limits.

Anaesthetic Drugs used:

Most dentists today (1958) use lidocaine* type anaesthetics as their local anaesthetic solution for injection. This is used predominantly in cartridge form, the ratio of cartridge to bottle forms used being 3 to 1. Almost insignificant amounts

*lidocaine—lignocaine (trade examples: xylocaine, xylotox, lidocaton, nurocaine, xylestesan).

FIGURE I

Questionnaire on Local Anaesthetics.

1. Please list the anaesthetic solutions used in your practice over the past two years. If more than one, would you indicate your order of preference, the approximate proportion of use in your practice, and whether you use cartridge or bottle.

Anaesthetic	Proportion of each used	Cartridge	Bottle

2. Have you personally experienced any dermatitis from your use of modern local anaesthetic solutions ?

☐ Yes

☐ No

Anaesthetic responsible

3. Do you vary the type of local anaesthetic or the solution used in cases of systemic diseases?

☐ Yes

☐ No

4. Do you premedicate before administration of local anaesthetics ?

(*a*) Routinely ☐

(*b*) Sometimes ☐

(*c*) Never ☐

Drug(s) used

5. If you believe local anaesthetic drugs are not completely satisfactory, what improvements would you suggest in a new local anaesthetic (if one could be formulated) ?

6. Do you use a topical anaesthetic for pre-injection purposes ?

☐ Yes

☐ No

Topical anaesthetic used

If not, if a more potent topical anaesthetic were available, would you use it ?

☐ Yes ☐ No

7. Which antibacterial agent(s) do you apply prior to the injection of a local anaesthetic solution ?

of other anaesthetic solutions are used. Furthermore, lidocaine type preparations seem to be used for more than 80 per cent. of the operations performed. If these results are representative for all the dentists in Queensland then there is far too much reliance on a single anaesthetic in expecting it to be satisfactory for all types of work. The questionnaire does not supply information as to whether this is because of economy or because of a lack of knowledge of modern anaesthetic developments and technique.

TABLE II

Dermatitis experienced by Queensland dentists.

	No. of Dentists	Confidence Interval
YES	2	0%— 14%
NO	48	86%—100%
TOTAL ..	50	

Dermatitis:

More than 85 per cent. of the dentists have never suffered from dermatitis resulting from the use of local anaesthetic drugs. Those who are affected seem to be restricted to para-amino-benzoic acid type anaesthetic allergy.

TABLE III

Variation of Local Anaesthetic by the dentists.

	No. of Dentists	95% Confidence Interval
YES	21	28%—57%
NO	29	43%—72%
TOTAL ..	50	

Anaesthetic agent for "risk" patients:

The results show that between 43 per cent. and 72 per cent. do not alter the type of anaesthetic or the constituents of the anaesthetic solution in cases for systemic diseases, frailty, extreme youth, etc. This seems sufficient evidence to indicate that, in the concentrations used in the practice of dentistry, the components of local anaesthetic solutions do not often cause serious reactions in "risk" patients.

TABLE IV

Use of Preanaesthetic Medication.

	No. of Dentists	95% Confidence Interval
Routinely ..		0 — 7%
Sometimes ..	40	66%—90%
Never	10	10%—34%
TOTAL ..	50	

TABLE V
Type of Premedication used.

Drugs Used	Ratio of Use	95% Confidence Interval
Sedatives ..	46—57	68%—90%
Analgesics ..	6—57	4%—22%
Miscellaneous ..	5—57	3%—20%

TABLE VI
Subdivision of Table V.

	No. of Dentists
(A) SEDATIVES—	
(1) Barbiturate Derivates	
(*a*) Pentobarbital (Nembutal)	16
(*b*) Quinalbarbitone (Seconal)	8
(*c*) "Nembudeine" (Pentobarb. + Codein)	4
(*d*) Amylobarbitone (Na Amytal)	2
(*e*) Phenobarbital	2
(*f*) "Barbideine" (Phenobarbital Na + Codein)	1
(*g*) Nembutal 1½—2 "Codis"—2 "Dispirin"	1
(2) Bromine—Urea Derivative (Relaxa Tablets)	1
(3) "Oblivon"	11
	46
(B) ANALGESICS	
(1) Codiphen (Acetyl Salicylic Acid—Phenacetin—Codein—Caffeine)	1
(2) Aspirin (Acetyl Salicylic Acid)	1
(3) Saridone—(Caffeine—Phenacetin—Pyrazone)	1
(4) Codein Tablets—(Codein Phosphate)	1
(5) Omnopon	1
(6) Pethocaine Hydrochloride	1
	6
(C) MISCELLANEOUS	
(1) Penicillin	1
(2) "K. Thrombin"	1
(3) Hypnosis	1
(4) No drugs listed	2
	5

Premedication:

Between 66 per cent. and 90 per cent. premedicate patients "sometimes" prior to giving local anaesthetic injections. However, from the information obtained, the greater number of dentists very rarely do so—probably only in extreme cases of apprehension. These results are similar to those obtained in the New York survey[18] (1958). Sedation is preferred to an analgesic drug by the majority of those who premedicate. The barbiturate derivatives are the most popular (reduced dosage of hypnotics used to procure sedation). Approximately 25 per cent. use "Oblivon". In the group of fifty dentists sampled in this survey, no one claimed to premedicate routinely before local anaesthetic administration.

TABLE VII
Need for Improvement in Present Anaesthetic Drugs.

	No. of Dentists	95% Confidence Interval
Satisfied with Present Preparations ..	13	15%—41%
Suggested Improvements	26	37%—66%
No Comment (Informal)	11	13%—38%
TOTAL	50	

TABLE VIII
Improvements suggested by dentists (from Table VII).

	No. of Dentists
(A) CONTROLLED DURATION	
(1) Shorter duration	9
(2) Post-operative antidote	3
(3) Controlled duration	3
(4) Series of combination anaesthetics	1
(5) Solutions with varying lengths of duration	1
	17
(B) LOWERED TOXICITY	
(1) No heart palpitation	2
(2) No "Adrenalin" reaction	2
(3) Reduction of adrenalin content	1
(4) Lowered toxicity	1
(5) Toxicity less affected by climate	1
(6) Lowered intraosseous toxicity	1
(7) Less post-operative discomfort	1
	9
(C) INCREASED POTENCY	
(1) Greater depth anaesthesia	2
(2) Increased potency of equal Cocaine	1
(3) Increased potency to allow infiltration of lower molars	1
	4
(D) MISCELLANEOUS	
(*a*) Application without injection	3
(*b*) Longer shelf life	2
(*c*) Quicker onset of anaesthesia	2
(*d*) Various sizes of cartridge for deciduous teeth	1
	8

Status of present anaesthetic drugs:

Only about one-third of Queensland dentists is perfectly satisfied with the available local anaesthetic agents. On the other hand the majority of New York dentists[18] was satisfied with currently available local anaesthetic drugs. Some agents in use in U.S.A. (*e.g.* primacaine) have not been readily available in Australia.

In the present survey, there were a number of improvements suggested. Grouped together, controlled duration and lowered toxicity were the most important improvements recommended. However, there are agents available which meet these requirements. The criticism may be made that the questionnaire "begs" this answer; yet, a different response was obtained in the American survey.[18] The suggestion in this present survey may be due to a tendency to rely on the routine use of a single anaesthetic agent, rather than to select the anaesthetic for each operation and for each patient. Once again, is this due to economy, or due to a lack of knowledge or application of modern developments? The questionnaire does not answer this. Certainly, a single anaesthetic agent cannot be expected to be satisfactory for every operation.

TABLE IX
Pre-injection application of topical Anaesthetic.

	No. of Dentists	95% Confidence Interval
YES	41	69%—91%
NO	9	9%—31%
TOTAL ..	50	

TABLE X
Topical Anaesthetic Drugs Used (from Table IX)

Drugs Used	No. of Dentists	95% Confidence Interval
Lidocaine Type	37	76%—100%
Ethyl Chloride	1	
Neotopanol	1	
Aconite—I_2—Chloretone	1	
Informal	1	
TOTAL	41	

TABLE XI
Number of dentists who would use topical anaesthesia if a more potent agent were available.

	No. of Dentists
YES	7
NO	2
TOTAL ..	9

Topical Anaesthesia:

Between 69 per cent. and 91 per cent. use topical anaesthesia before the injection of a local anaesthetic drug. Of those who did not use topical anaesthesia the majority favoured its use in principle, but were not satisfied with available preparations. Almost identical results were obtained by Kutscher and Mercadante,[12] (1958), in their survey. Lidocaine type preparations are favoured by at least three-quarters of those who apply topical anaesthetic mixtures before injection.

TABLE XII

Number of dentists who apply antibacterial agent(s) before injecting

	No. of Dentists	95% Confidence Interval
YES	42	71%—93%
NO	8	7%—29%
TOTAL ..	50	

TABLE XIII

Antibacterial Agents Used

Drugs Used	Sub-Division	No. of Dentists	95% Confidence Interval
(A) HALOGEN ..	Iodine Solutions	26	37%—66%
(B) METAL SALTS	Metaphen Mercurochrome	7 1	
(C) ANTISEPTIC DYES	Proflavine Acriflavine Monacrin	1 1 1	
(D) DETERGENT SOLUTIONS	Zephiran Cetavlon-Cetrimide Detergent Solution	1 2 1	
(E) ANTIBIOTICS	Aureomycin	1	
TOTAL		42	

Antibacterial agents:

The majority of dentists (greater than 70 per cent.) claim that they use an antiseptic solution at the site of injection. Similar claims are reported in the American survey[18] (1958). Iodine tinctures are the most popular—used by 37-66 per cent. Organic mercurial antiseptics (*e.g.* metaphen and merthiolate) are not widely used in Queensland.

SUMMARY

1. A survey was made on the use of local anaesthetics by Queensland dental practitioners.
2. A representative sample technique was employed (50 being the size of the sample), and estimations of the true values for the whole "population" of Queensland dentists made within 95 per cent. confidence limits.

3. (i) Lidocaine type anaesthetic preparations are well established as the most popular anaesthetics in use.

   (ii) Only a very small percentage of Queensland dentists has experienced dermatitis from the use of modern preparations.

   (iii) Most of the local anaesthetic preparations available today are used for the majority of patients presenting to a general dental practitioner without severe reaction.

   (iv) At least 66 per cent. of Queensland dentists premedicate "sometimes" prior to injection. Sedative drugs are certainly the most popular and the majority favoured barbiturate derivates.

   (v) Controlled duration and lowered toxicity of the agent are improvements suggested by the dentists in this survey.

   (vi) At least 69 per cent. of the dentists make use of topical anaesthetic application before injection, lidocaine types being the most popular.

   (vii) At least 70 per cent. use an antiseptic for preparation of the field of injection: iodine tinctures are those most commonly used.

4. The results of this survey are compared with a recent American survey on local anaesthesia.

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BIBLIOGRAPHY

1. ADRIANI, J. Selection of Anaesthesia—Local Anaesthetics, Oxford. Blackwell Scientific Publications, 1st ed., 1955 (p. 95).
2. ARCHER, W. H. A Manual of Dental Anaesthesia. Philad. and Lond., W. B. Saunders Co., 1st ed., 1952.
3. BEGAUX, F. The Clinical Efficiency of Primacaine. *Mod. Dent.*, **24**: 14-19 (May), 1957.
4. BJORN, H. A survey of Recently Introduced Drugs for Local Anaesthesia. *Odont. Revy.*, **7**: 3,305-353, 1956.
5. BROADBENT, B. G. Solutions and Allied Drugs for use in Dentistry. Recent Advances in Local Anaesthetics. *Aust. J. Dent.*, **58**: 14 (Feb.), 1954.
6. BROADBENT, B. G. Local Anaesthetics—New Solutions: Old Fallacies. *Dent. J. Aust.*, **27**: 67, 1955.
7. BROADBENT, B. G. Primacaine Hydrochloride—A New Local Anaesthetic Agent. *Aust. Dent. J.*, **2**: 194-200 (April), 1957.
8. COWAN, A. A Clinical Comparison of Xylocaine Anaesthesia. *J. Dent. Res.*, **35**: 824-839 (December), 1957.
9. CUTLER, R. Ravocaine: A Clinical Study of a New Local Anaesthetic. *The Dent. Practit.*, **4**: 338-344 (July), 1954.
10. DOBBS, E. C. L-Nordefrin (Levo-Cobefrin). *J. Dent. Res.*, **33**: 705 (Oct.), 1954.
11. FISHER, R. A. AND YATES, F. Statistical Tables for Biological, Agricultural and Medical Research. New York, Hafner Pub. Co., 4th ed., 1953 (p. 117).
12. GLOVER, J. Local Anaesthetics in Dentistry. *Aust. J. Dent.*, **57**: 87-95 (April), 1953.
13. GODOY, F. G. AND DUVAL, E. Procaine and Propoxycaine as Local Anaesthetic Agents in Children. *Dent. Abstract*, **1**: 91-92 (Feb.), 1956.

14. GOODMAN, L. S. AND GILMAN, A. The Pharmacological Bases of Therapeutics. N.Y., The Macmillan Co., 2nd ed., 1955 (p. 354).

15. GRAY, C. AND GEDDES, I. C. A Review of Local Anaesthetics. *J. Pharmacy and Pharmacol.*, **6**: 89-114, 1954.

16. HARRIS, T. A. B. The Mode of Action of Anaesthetics. Edinburgh, E. & S. Livingstone, 1st ed., 1951 (p. 321).

17. JURGENS, P. E. A Study of Efocaine. *J. Dent. Res.*, **33**: 665 (Oct.), 1954.

18. KUTSCHER, A. H. AND MERCADANTE, J. Local Anaesthesia: Results of Co-operative Research Survey III. *N.Y. State Dent. J.*, **24**: 210-214 (May), 1958.

19. MONHEIM, L. M. Local Anaesthesia and Pain Control in Dental Practice. St. Louis, The C. V. Mosby Co., 1st ed., 1957 (p. 22, 133).

20. MONSOUR, F. N. The Efficiency and Toxicity of Modern Dental Local Anaesthetic Solutions. Thesis, B.D.Sc. with Honours, 1959.

21. OFSTAD, B. Recent Dental Local Anaesthetics. *Int. Dent. J.*, **2**: 229-247 (Dec.), 1949.

22. ORINGER, M. H. The Roles of Minimal Dosage and Vasoconstriction in Safety and Efficiency of Local Anaesthesia. *Oral Surg.*, **2**: 1566-1574 (Dec.), 1949.

23. SELDIN H., SELDIN, S. D., RAKOWER, W., SELMAN, A. J. Untoward Reactions to Efocaine. *J. Oral Surg.*, **13**: 66-67 (Jan.), 1955.

24. SHERMAN, H., FIASCONARO, J. E., CHILTON, N. W. A Comparison of the Clinical Effectiveness of the Higher Potency Local Anaesthetics in Operative Dentistry. *J. Amer. Dent. Ass.* **48**: 151-157 (Feb.), 1954.

25. SHERMAN, H., FIASCONARO, J. E., GRUNDEFEST, H. Clinical Efficiency of Recent Local Anaesthesia. *N.Y. State Dent. J.*, **23**: 403-413 (Dec.), 1957.